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SOME FIELD OBSERVATIONS ON *NUYTSIA FLORIBUNDA* (LABILL.) R.BR.

By THOMAS GÖBEL*

INTRODUCTION

All authors describing the aspects and peculiarities of the Western Australian flora mention the monotypic *Nuytsia floribunda* and point to its peculiar appearance; for example in the recent works of Morcombe (1968), Seddon (1972) and Erickson (1973) and others. The authors usually mention the following characteristics:

(1) *Nuytsia* is one of the three genera of the family of Loranthaceae rooting in the ground. The second genus which is also found in Australia, *Atkinsonia,* is also monotypic; the third, *Gaiadendron,* contains a few species in South America.

(2) The abundance and magnificence of its blossoms, blooming from December until the middle of January and especially copious after forest fires.

(3) The arborescence and size which is unique among the Loranthaceae.

(4) The secondary bend of the boughs related to the development of more than one cambium ring.

(5) The growth of very long root-runners which produce the root-suckers thereby providing for the vegetative propagation of the plant. (Regeneration by means of seeds seems to be exceptional).

Beyond these there are only very few specific studies of *Nuytsia.* Herbert (1918) was the first to find out that it is a root parasite. Diels (1906) doubted its parasitism; because in some cases he could not find any suitable host plants within a considerable distance around the plant. He writes: "It would be—at least for the full-grown state of the tree—a very forced assumption, if one imagined that it takes its nutrition from the roots of those comparatively dwarf shrubs thriving scantily at its feet." Grass, later discovered as a possible host by Herbert, was not even taken into consideration.

Further descriptions of the parasitism of *Nuytsia* are to be found in Ewart's (1930) study; he writes that carrot root crops are parasitized. McKee (1952) found the roots of neighbour plants parasitized. Main (1947) presents a study in which he draws attention to the poor germinative faculty of *Nuytsia* seeds and the difficulties of artificial propagation. Narayana (1955, 1958) worked on the morphology of the blossom and the embryology. Beyond these only a few scattered remarks are to be found

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in literature. Seddon (1972), for example mentions the length of the root-runners and Kuijt (1969) reports that by producing specific enzymes the haustoria can attack even synthetic materials. A telephone cable cut by *Nuytsia* is exhibited in the Western Australian Herbarium.

In spite of its conspicuous appearance and morphological, histological and physiological peculiarities *Nuytsia* has not been studied very much. Therefore it seems appropriate to report on a series of field observations which the author carried out from December 21st to December 27th, 1973. They pertain to the morphology and the leaf position of a one-year-old root-sucker and the shape of the underground stem of a young plant.

THE AREA OF OBSERVATION

The observation area was located 22 km east of Augusta, 2.4 km north of the Scott River. It covers 250 m to the north-south and 100 m to the east-west. This area was chosen because it came closest to the author's idea of a natural habitat of *Nuytsia*. That may be wrong. In any case, it has already become difficult nowadays to find natural habitats of *Nuytsia*. In an area ranging from 64 km north of Geraldton (the most northerly *Nuytsia* observed), across the Swan Coastal Plain and the Darling Range down to Albany in the south, the author happened on only one other extensive habitat. This was on a sandy rise near the Harris River, 8 km east of Treesville, between Collie and Quindanning. However, neither root-suckers nor very old plants were to be found there. The cause for the scarcity of undisturbed habitats is the almost complete agricultural exploitation of the Swan Coastal Plain and the increasingly extensive agricultural and forestry developments in the Darling Range and the area between Bunbury, Augusta and Albany. The search for such habitats was pursued over a period of 16 days. The study area was a flat south-west slope of a sandy rise, apparently the furthest one to the north-west of a series of such, stretching from the observation post to the south and the east. To the west stretched a flat swamp bearing heathy vegetation, while the rise itself was wooded. The trees consisted mainly of Jarrah *(Eucalyptus marginata)* intermixed with a few (5%) Marri *(Eucalyptus calophylla)*. In the second zone of trees *Banksia ilicifolia* was rather frequent whereas *Nuytsia floribunda* was rarer. There was a total lack of brushwood in the observation area. However, a great deal of burnt or dried up shrubbery was found. These and the fresh layer of carbonized remains as well as the great number of one-year-old *Acacia* seedlings pointed to the fact that the area was burnt in 1972. In the herbaceous zone there were loosely spread *Carex* species, beside the *Acacia* seedlings and one-year-old root-suckers of *Nuytsia floribunda*. These root-suckers grow in clusters on areas of 60-140 m^2, sometimes very close together, 10 to 30 specimens on the square metre, mostly, however, 4 to 10. Mosses and lichens were not observed. The soil in the observation area consisted of medium to fine-grained sand. Except for the upper 3 to 5 cm of the soil profile appearing grey to grey-black, there was no differentiation into strata down to a depth of 120 cm. The colour of the soil from 5 to 120 cm varied from a light grey to a faint yellow. The soil was perfectly light without any clay. The moisture did not change with depth. It stayed fresh.

Figure 1 gives a general view of the location with the young *Nuytsia floribunda* in the centre which was dug out a little later.

THE OCCURRENCE OF *NUYTSIA FLORIBUNDA* IN THE OBSERVATION AREA

Two loosely growing clusters of *Nuytsia floribunda* with a few younger plants in between were found in the observation area. Only the northerly cluster had a very old full-grown specimen of 14 m in height. It grew on the edge of an open space in the west that passed into the swamp. In its surroundings 11 younger specimens were found. The second group at the south end of the explored area consisted of 16 younger to middle-aged specimens. The distance between the specimens was 4 to 22 m. The root-suckers which had obviously developed only after the forest fire of

1972 were only rarely found near the older specimens, except for those growing immediately around the base of the trunks. They seemed to prefer the lighter spaces of the stock.

THE MORPHOLOGY OF A ONE-YEAR-OLD ROOT-SUCKER

A suitable root-sucker was chosen for examination. If possible it should have grown without a bend in the main stem. The additional sub-shoots ought to be regularly developed on all sides. (If the root-suckers grow closely together their additional shoots appear to be checked by the

FIG. 2

FIG. 1

Fig. 1.—General view of the observation area with the young *Nuytsia floribunda* (leaning) which was dug out.

Fig. 2.—The *Nuytsia floribunda* dug out as a whole; its dimensions are set out in Table 2, p. 56.

others.) There were 73 leaved nodes counted on the chosen root-sucker, only the two next to the roots had no leaves (lost?). The leaves closest to the ground were visibly broader and shorter than the following ones. They passed continuously into the lanceolate shape by 3 or 4 leaves. The two leaves at the top apparently had not yet stopped growing. They were visibly smaller and of a lighter shade. Past the 73rd leaf on the 75th node towards the top a zone of growth was found with buds and internodes, that had not come to an end with their formation and lengthening. Nodes with buds could be made out by means of a magnifying glass up to the 83rd. Additional shoots were found without exception in the axils of the leaves of nodes 16 to 41. The additional shoots were distributed as follows on the 42nd to 54th nodes:

+ = with additional shoot — = without additional shoot

nodes:	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
	+	+	—	+	+	—	+	+	—	+	—	+	—	—	+	—	—
			△												△		
			first node without add. shoot												last node with add. shoot		

Table 1 was included in order to show that the length of the internodes reveals a certain rhythm. In two sequences the 5th internode respectively is lengthened. The two sequences were marked A and B. (In order to mark the different internodes of these sequences they were given the ordinal number of the node below). Thus sequence A consists of the internodes 30, 35, 40, 45, 50, 55, 60, 65, 70, 75 and sequence B of the internodes 27, 32, 37, 42, 47, 52, 57, 62, 67, 72. If one compares the length of the internodes (Table 1) of the two sequences it is obvious that A is dominant towards the top, B towards the root. (The length of the internodes in that sequence begins unsystematically in the lower part). The first systematic lengthening can be observed at internode 14. Then follow 18, 23, 27 and 32. The differences here are 4, 5, 4, 5. The difference remains 5 within sequence B up to the topmost measurable internode (72). One more lengthened internode (68, 73) follows the two topmost internodes (67, 72) immediately. Sequence A starts, yet indistinctly, at internode 30 and after internode 60, it overtakes the length of sequence B.

In order to find out the leaf position of this root-sucker the angle formed by two adjacent central leaf axes and the stem was measured on a number of leaves (accuracy of ± 0.5°), i.e. on the nodes 33 to 52. The result was a median angle of 136°, 54' with a maximum spread of 2.5°. This satisfies quite exactly a leaf position of 8/21, the mathematical equivalent is an angle of 137°, 8', 4". A leaf position of 8/21 of the leaves of dicotyledons seems to be a rare exception. If one takes into consideration that each of the two sequences of lengthened internodes (A and B) correspond to a distichous leaf position, the sequences A and B run along the main stem on approximately opposite sides.

THE MORPHOLOGY OF A ROOT-STOCK OF *NUYTSIA FLORIBUNDA*

In order to understand the morphology of the root-stock of *Nuytsia floribunda*, the root of a younger specimen was dug out. Thus many haustoria could be found. The smallest (youngest?) of the examples in the observation area was chosen. It could be distinguished from all other individuals by the fact that the main stem did not show the bend so typical of later age. The trunk itself was 5.18 m high, the main stem having died away by burning at 4.90 m. It had already been replaced by an additional shoot of equally vertical growth. At its base the trunk (including the bark) had a diameter of 177 mm; at 30 cm above the surface it was 148 mm; at 100 cm, the same, and at 500 cm, 18 mm

TECHNIQUE OF DIGGING

In order to gain a suitable starting-point for the search of haustoria a ditch was dug from the foot of the trunk to the south, 50 cm deep, 50 cm wide and 100 cm long. Two hausoria were found accidentally. After that

TABLE 1

Ord. Number of the node	Height of Insertion (mm)	Length of Internodes (mm)	addition shoot yes + no —	length (mm)
1	0	—	—	
2	1	1	—	
3	2	1	—	
4	9	7	—	
5	9	0	—	
6	10	1	—	
7	13	3	—	
8	14	1	—	
9	17	3	—	
10	22	5	—	
11	28	6	—	
12	28	0	—	
13	30	2	—	
14	39	B 9	—	
15	42	3	—	
16	48	6	+	180
17	51	3	+	256
18	61	B 10	+	2
19	65	4	+	99
20	69	4	+	190
21	73	4	+	221
22	75	2	+	252
23	87	B 12	+	190
24	96	9	+	195
25	98	2	+	228
26	99	1	+	267
27	112	B 13	+	237
28	115	3	+	248
29	122	7	+	217
30	130	8	+	228
31	133	3	+	209
32	145	B 12	+	215
33	149	4	+	193
34	154	5	+	213
35	164	A 10	+	225
36	166	2	+	206
37	173	B 7	+	123
38	178	5	+	99
39	184	6	+	104
40	193	A 9	+	138
41	194	1	+	107
42	204	B 10	—	
43	207	3	+	48
44	213	6	+	106
45	223	A 10	—	
46	223	0	+	114
47	233	B 10	+	76
48	238	5	—	
49	245	7	+	106
50	256	A 11	—	
51	257	1	+	101
52	269	B 12	—	
53	272	3	—	
54	281	9	+	38
55	292	A 11	—	
56	298	6	—	
57	309	B 11	—	
58	316	7	—	
59	323	7	—	
60	333	A 10	—	
61	339	6	—	
62	348	B 9	—	
63	355	7	—	
64	362	7	—	
65	372	A 10	—	
66	377	5	—	
67	386	B 9	—	
68	396	10	—	
69	401	5	—	
70	412	A 11	—	
71	417	5	—	
72	425	B 8	—	
73	434	9	—	
74	439	5	—	
75	451	A 12	—	

the remaining wall was dug out from beneath with a small shovel so that the sand from above came crumbling down. Now and then some knocking and scratching with the hand from below was helpful. By this method no finer roots were injured. In this way a circular area, 200 cm in diameter and 50 cm deep was dug out.

DISTRIBUTION OF THE HAUSTORIA

It turned out that haustoria were developed only in the upper 10-12 cm of the soil around very fine roots, mostly of *Carex* sp., in some cases

Fig. 3.—Haustoria of *Nuytsia floribunda*.

of *Eucalyptus* spp. A total of 64 haustoria were found which appeared to be snow-white in colour as described by Herbert (1918) and which surrounded the host-root in a ring. In two cases the haustoria did not connect into a ring. The exterior diameter of the haustoria lay between 2.5 mm and 8 mm. Fig. 3 shows a haustorium of 6 mm in diameter.

The *Nuytsia*-root to which a haustorium belongs, was in every case thinner than 0.5 mm and equally white. All haustoria-bearing *Nuytsia*-roots did not spring from the trunk itself but from the abundant number of root-suckers that sprang from the root-neck of the main trunk 6-10 cm deep in the ground (Fig. 4).

After it had become evident that there would be no further haustoria in the deeper layers, digging into the depth was continued without any special precaution.

THE SHAPE OF THE UNDERGROUND STEM

The underground stem had the shape of a turnip which changed 85 cm below the surface from the vertical to a horizontal tap-root spreading immediately into 4 roots (Fig. 5). Furthermore nine other roots were made out springing horizontally from the turnip-root in a depth of 70-78 cm and rising vertically at some further distance. Table 2 gives the measurements of the turnip-root and the diameters of the roots.

Fig. 2 shows the *Nuytsia floribunda* which was dug out as a whole. A closer look at the surface of the turnip-root shows that it is covered with

TABLE 2.—DIMENSIONS OF THE STUDY TREE

TRUNK and UNDERGROUND STEM			ROOT	
Position	Girth (mm)	diameter (mm)	No.	/ diameter at a distance of 20 cm from the turnip-root (mm)
30 cm above the surface		148	1	60
10 cm above the surface		170	2	52
surface		177	3	104
14 cm below the surface	1,190	379	4	78
30 cm below the surface	1,325	422	5	92
40 cm below the surface	1,475	470	6	84
50 cm below the surface	1,340	433	7	57
60 cm below the surface	122	388	8	28
85 cm below the surface		60	9	32
			10 a	40
			10 b	35
			10 c	26
			10 d	22

ring-shaped bark-folds. These are presumably the cicatrized remains of withered root-runners. That means, however, that the root-runners are periodically replaced by new roots at greater depth. This is supported by the fact the root marked 3 had withered at a distance of 1.10 m from the turnip root. Only very little amount of organic remains was found in front of the still living stump. Another fact speaks in favour of this: root No. 3 with a diameter of 104 mm was the strongest and at the same time the one in the least depth (60 cm).

Fig. 4.—Root-suckers of *Nuytsia floribunda* which spring from the root-neck of the main trunk.

In the end an attempt was made to dig out root No. 6. This plan was given up after 21 m. Table 3 gives the diameters of the root at every metre. Only one branch was found on the total length of that root and that at a distance of 19 m from the foot of the trunk where a root of 22 mm in diameter branched off to the front in an acute angle.

After cutting the part of the trunk above the ground, a colourless gum flowed out, especially intensely in a ring of 1 cm width, measured from the bark to the centre. This flow continued for about 24 hours. The gum coagulated into a sticky substance that stood up like hair over the milk

Fig. 5.—Four views of the underground stem of *Nuytsia floribunda.*

TABLE 3

length (m)	diameter (mm)	length (m)	diameter (mm)	length (m)	diameter (mm)
0	89	8	44	15	43
1	64	9	41	16	46
2	59	10	41	17	43
3	50	11	43	18	43
4	47	12	43	19	43
5	46	13	45	20	39
6	44	14	45	21	39
7	42				

tubules. A light-green gum, however, flowed from the turnip-root and took a little longer to coagulate into drops. The zone in the root from which the gum ran was 8 cm wide and lay in the exterior third of the cross-section. The root-runners had the light-green gum flow across the total cross-section.

The existence of such an important storage organ as the turnip-root of that enormous size compared to the above-ground part of the plant, explains perhaps the magnificence of the blossoms of *Nuytsia floribunda* especially after forest fires. Specimens were seen by the author blooming abundantly with yellow flowers and bearing no single leaf capable of assimilation.

The observations described here are single cases and need repetition before the leaf position and the existence of a turnip-root can be taken as an established generalisation. To assess the possible significance of the turnip-root, repeated observations would be desirable.

SUMMARY

Near Augusta in Western Australia a one-year-old rootsucker and an entire young plant of *Nuytsia floribunda* were observed with regard to their morphological characteristics. Two sequences of internodes of the rootsucker, belonging to two approximately opposite distichs of the leaf position, are promoted before all others. The leaf position of this shoot is 18/21. The younger specimen which was dug out with a trunk of 15 cm in diameter, 30 cm above the ground, had a turnip-root of 85 cm length and a maximum diameter of 47 cm. The magnificence of the blossoms of *Nuytsia floribunda* especially after forest fires in the leafless state can possibly be explained by the great nutritive reservoir of the underground turnip-root.

Verifications of these isolated observations are essential.

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AN OBSERVATION OF THE PHEASANT-TAILED JACANA IN WESTERN AUSTRALIA

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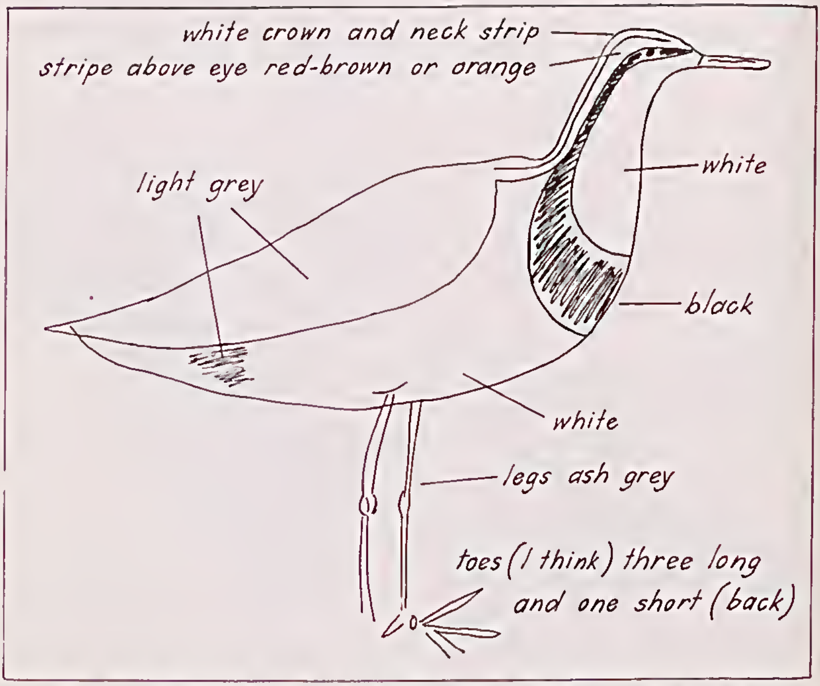
Early this year Mr. Joseph A. Smith sought our help in identifying a strange bird he saw on 22 December, 1974 at the north-western iron-mining town of Paraburdoo (23°12'S, 117°40'E).

Mr. Smith wrote, "Here's a mystery for you to solve, nothing like it in Cayley's or Slater's books. Seen feeding in water's edge at sewage pond. Legs long (about 9 or 10 inches) and toes (front) seemed quite long. The black band across its chest 2 inches wide at base and narrowing as it reaches eye. With the brown-coloured stripe on each side of its head down to the shoulder and the white central strip [of crown] and bib and belly it is quite an attractive bird. Height of bird seen next to a Black-tailed Water Hen about 3 inches shorter. When I saw it fly,



Copy of field sketch by Mr. J. A. Smith of the Pheasant-tailed Jacana.